Remarks

Status of the claims

Claims 1-11, 13, and 25-30 are pending, with Claims 1, 13, 28, and 30 being independent. Claims 1, 13, 28, and 30 have been amended. Applicants submit that support for the amendments can be found in the original disclosure. Therefore, no new matter has been added.

Requested action

Reconsideration and withdrawal of the outstanding rejections are respectfully solicited in view of the foregoing amendments and the following remarks.

Applicants also respectfully request that this Amendment be entered. This Amendment could not have been presented earlier as it was earnestly believed that the claims on file would be found allowable. Given the Examiner's familiarity with the application, Applicants believe that a full understanding and consideration of this Amendment would not require undue time or effort by the Examiner. Moreover, for the reasons discussed below, Applicants submit that this Amendment places the application in condition for allowance. At the very least, it is believed to place the application in better form for appeal. Accordingly, entry of this Amendment is believed to be appropriate and such entry is respectfully requested.

Rejections

Claims 1, 2, 5, 6, 9, 10, 13 and 25-28 are rejected under 35 U.S.C. § 102(e), as being anticipated by the patent to Osaka et al. (U.S. Patent No. 6,023,277). In addition, Claims 3, 4,

11, 29, and 30 are rejected under 35 U.S.C. § 103(a), as being unpatentable over the patent to Osaka et al. Claims 7 and 8 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the patent to Osaka et al. in view of the patent to Ishikawa et al. (U.S. Patent No. 6,549,650 B1).

Summary of December 19, 2005 Interview

Applicants appreciate the courtesy extended by Examiner Pappas in granting and conducting a personal interview with Applicants' representative on December 19, 2005. Following is a summary of the substance of the interview.

Applicants' representative first explained the context of the claimed invention, i.e., that it relates to a particular type of 3D display apparatus. As described in the Background of the Invention section of the present application, one type of conventional 3D display apparatus uses the principle of binocular parallax. In this type of apparatus, a stereoscopic image is displayed utilizing the binocular parallax of the left and right eyes. However, because the convergence and the focal length differ, the user can feel fatigue or discomfort. See, e.g., page 1, lines 15-24. Applicants' representative further explained that another conventional 3D display apparatus projects multiple images from different viewpoints to an observer's eye sequentially with very little time between them, and relies upon the persistence of vision to create a stereoscopic image. As with the former type of apparatus, however, in this latter type of apparatus it is likewise the case that there is a difference between the perceived location of the 3D image in space and the actual location of the projected images on an image plane, and this difference may adversely affect the observer.

As described at page 2, lines 3-22 and page 6, line 20 through page 7, line 13 of the specification, as well as in the cited article entitled "3D Display Using Light Beam Reconstruction Method," yet another known type of apparatus displays a 3D image by projecting parallel light beams of very small diameter and deflecting them so that rays cross each other at given locations in three-dimensional space. If two or more rays forming an intersection enter the eye of the observer, the light flux from the intersection is perceived as a point image. A large collection of intersections (i.e., perceived point images) is recognized as a 3D image. Since the focus of the observer is at the ray intersections in 3D space, rather than on projected images on an image plane, the problem of fatigue and uncomfortableness in the observer is alleviated.

However, this third type of 3D display apparatus has a drawback in that the image data used by this type of display apparatus to generate the rays forming a 3D image is typically in a special format that differs from conventional parallax images that are used by the binocular parallax type of display. Hence, while the type of apparatus using the binocular parallax principle can easily utilize parallax images captured by a camera, the ray intersection type of apparatus requires data in a special format and conventionally has been useful only for displaying computer-generated images. Accordingly, the presently claimed invention is directed to generating image data for the ray intersection type of 3D display apparatus using a plurality of parallax images.

During the interview, the Examiner focused his attention extensively on the details of how the ray intersection type of display apparatus operates. As Applicants' representative indicated during the interview, that type of apparatus is known and the details can be found in the article mentioned above, which is cited at page 2 of the specification and was cited in the

Information Disclosure Statement filed on November 10, 2004. The pending claims do not purport to claim the ray intersection type of apparatus as the present inventors' invention; instead, that type of apparatus provides the context for the pending claims, which relate to a method and apparatus for generating data in the format required by the ray intersection type of 3D display apparatus using a plurality of parallax images.

Applicants' representative explained how the language of the claims distinguished over the cited patent to Osaka et al. That patent discusses the use of binocular parallax and volume scanning as techniques for generating a 3D image, but that patent does not disclose or suggest the ray intersection type of display apparatus discussed above. In particular, although the Examiner has pointed out that Figs. 2 and 22A-B of Osaka et al. show intersecting rays, that patent does not disclose or suggest that rays from those intersections enter into an eye of an observer to be viewed as light flux, such that the observer recognizes the intersections as point images. To the contrary, those figures show that the intersecting rays diverge so that generally only one ray from any intersection enters an observer's eye. Thus, Osaka et al. does not show that a plurality of rays from each intersection enter an observer's eye, which is needed for the observer to recognize the intersections as point images.

Response to Rejections

While Applicants believe that the claims are allowable for the reasons noted above during the December 19, 2005 interview, Applicants have further amended the claims to even more clearly recite the novel features of the present invention. Applicants submit that as amended, the claims are allowable for the following reasons.

Independent Claim 1 relates to a 3D image data generator that generates 3D image data for a 3D display apparatus.

Claim 1 has been amended to recite that the 3D display apparatus emits a plurality of very small diameter parallel rays arranged at high density and deflects the rays to form intersections of the plurality of rays at selected locations in 3D space. Claim 1 has also been amended to recite that a plurality of rays from each intersection enter into an eye of an observer, such that the observer views the intersecting rays as light flux and recognizes the respective intersection as a point image. In addition, Claim 1 has been amended to recite that a large collection of intersections are formed at locations in 3D space so as to form a 3D image. Finally, Claim 1 has been amended to recite that the data generator comprises a control unit that generates 3D image data usable by the 3D display apparatus by using a plurality of parallax images.

By this arrangement, the present invention can enable the making of a plurality of point light sources artificially at selected locations in 3D space, by generating data usable by the 3D display apparatus to emit rays to form intersections of rays intentionally in front of the observer's eye. The observer will recognize that rays which constitute the light flux come from each intersection and will recognize the intersection as a point image. A collection of these kinds of point images (i.e., intersections), if arranged to constitute a certain shape in 3D space, makes an observer recognize the existence of that shape in 3D space.

More generally, an observer will recognize the existence and shape of a certain object based on visual information detected by his or her eyes. That visual information can take two forms. The first form is light reflected from objects directly into an observer's eyes. In this case, the observer recognizes the existence and shape of an object, which does exist in 3D space. The

second form is light from intersecting rays intersecting at an intersection point that are projected into the observer's eyes. The observer interprets these intersecting rays as a point image. A large collection of these intersections or point images, if arranged to constitute the image of a certain 3D object, allows the observer to recognize a 3D image of an object, even though the object is not present.

In contrast, the patents to Osaka et al. and Ishikawa et al. are not understood to disclose or suggest a 3D image data generator that generates 3D image data for a 3D display apparatus that emits a plurality of very small diameter parallel rays arranged at high density and deflects the rays to form intersections of the plurality of rays at selected locations in 3D space, wherein *a plurality of rays from each intersection enter into an eye of an observer, such that the observer views the intersecting rays as light flux and recognizes the respective intersection as a point image*, as recited by amended Claim 1. In addition, these patents are also not understood to disclose or suggest that a large collection of these intersections are formed at locations in 3D space so as to form a 3D image, as also recited by amended Claim 1.

Rather, the patent to Osaka et al. is understood to adopt a principle of stereoscopic display based upon a crossed-lenticular lens scheme. In this patent, left and right parallax images are understood to be observed upon being separated by a lenticular lens for viewing by both eyes of a user so that the user recognizes 3D object images.

The Office Action points out that there are intersections of a plurality of rays in Fig. 22B of Osaka et al. (circled portions between element EL and 201). But, such intersections are not understood to ever affect the observer's view, because they are not understood to be recognized

as point images and there is not understood to be a large collection of the intersections to form a 3D object image.

More specifically, Fig. 22A of the patent to Osaka et al. is understood to show only that irradiated rays from backlight 3 are directed at an observer's right eye (ER) and Fig. 22B is understood to show only that irradiated rays from backlight 3 are directed at an observer's left eye (EL). And Fig. 24 is understood to show merely the combining of right parallax images and left parallax images, where the right parallax image R is an image for the right eye of the observer and left parallax image L is an image for the left eye of the observer. Thus, since the observer sees only the right parallax image or left parallax image with his or her right or left eye, respectively, he or she can recognize 3D images. And in this patent, the recognized images are understood to be displayed on the display itself. Accordingly, the intersection shown in the patent to Osaka et al. is merely understood to be an intersection that does not affect the observer's view and is not understood to be formed by a large collection of intersections at locations in 3D space to form a 3D image.

In the patent to Ishikawa, et al., a stereoscopic display with a lenticular lens or liquid crystal shutter spectacles is adopted to generate 3D object images.

Thus, these patents are not understood to disclose or suggest that a plurality of rays from each intersection enter an observer's eye, which is needed for the observer to recognize the intersections as point images. In addition, these patents are not understood to disclose or suggest a large collection of intersections formed at locations in 3D space so as to form a 3D image.

For the foregoing reasons, Applicants submit that the present invention recited in Claim 1 is patentable over the art of record. Independent Claims 13, 28, and 30 recite similar features and

are believed patentable for similar reasons. The dependent claims are believed patentable for at least the same reasons as the independent claims, as well as for the additional features they recite.

Request for Interview

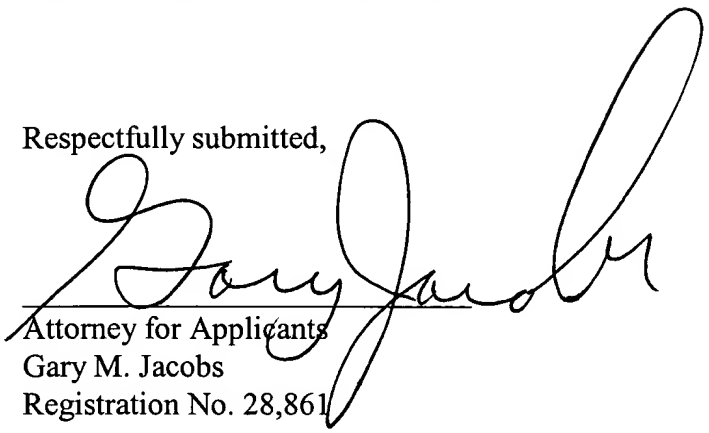
Applicants believe a personal interview may be helpful to advance prosecution of this application. Accordingly, when the Examiner receives this Amendment he is requested to contact Applicants' undersigned representative to schedule an interview.

Conclusion

In view of the foregoing, Applicants submit that this application is in condition for allowance. Favorable reconsideration, withdrawal of the above-mentioned objections and rejections, and an early Notice of Allowance are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our below-listed address.

Respectfully submitted,



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